water polo players, 4 rowers, 2 volleyball players, 2 synchronized swimmers, 1 wrestler, and 1 diver. Twenty-five (65%) of the athletes presented with nTOS and 13 (34%) had Paget Schroetter Syndrome (PSS). All PSS patients underwent standard treatment of thrombolysis followed by first rib resection. Most nTOS patients were treated according to a highly-selective algorithm beginning with TOS-specific physical therapy. Based on symptom improvement after PT, 64% of the nTOS athletes ultimately underwent first rib resection and brachial plexus neurolysis. Return to full competitive athletics was achieved in 79% of all patients, including 100% of the PSS patients and 72% of the nTOS athletes. In the nTOS cohort successfully returning to sports, six (33%) were treated only with PT. If the athlete underwent surgery for nTOS, 75% returned to full competitive levels. Mean QD scores improved from pre-op (36) to post-op (12) indicating minimal disability. Recurrence of symptoms was noted in two nTOS (8%) and two PSS (15%) athletes.

Conclusions: Standardized treatment algorithms and aggressive TOS-specific physical therapy are key components to minimizing disability in this special cohort of TOS patients. The majority of athletes treated for neurogenic and venous TOS can successfully return to competitive sports at their prior high performance level.

Axillosubclavian Vein Thrombosis or Paget Schroetter Syndrome: Outcomes of Alternative Surgical Approaches

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Objectives: Axillosubclavian vein thrombosis is an uncommon presentation of thoracic outlet syndrome. Treatment varies widely and includes first rib resection (FRR) alone, lysis and FRR + open surgical venous reconstruction, and FRR followed by endovascular therapy (EVT) for residual stenosis. This study reviewed our experience with alternative management algorithms.

Methods: We retrospectively reviewed all venous TOS (vTOS) patients undergoing operation from 08/1995-11/2012. Charts were reviewed and patients divided into two groups. Group I patients underwent thrombolysis followed by FRR + open venous reconstruction. Group II patients underwent thrombolysis and FRR, +/- subsequent EVT. Patients were distributed evenly between acute (< 2 weeks) and chronic (> 2 weeks) presentations.

Results: Twenty-two vTOS patients initially underwent thrombolysis. Mean age was 28.7 years (range, 18-55); 13 (59%) were men. Group I (12/22 = 55%) patients were treated with open venous reconstruction: 10 patch angioplasty, 1 IJ turndown, and 1 femoral vein interposition graft. All had FRR, except one, who had medial claviculectomy. Group II (10/22 = 45 %) consisted of nine patients who underwent FRR. One required PTA for residual stenosis post FRR; 7 had subsequent venography showing no residual compression. One patient had no FRR as the postlysis venogram failed to showed compression. Symptoms were relieved in 21/22 (95.5%) patients. Mean follow-up was 336 days (range, 0-1153). Perioperative complications occurred in 9 (75%) Group I patients, including recurrent thrombosis requiring EVT in 2, chest wall hematoma or hemothorax requiring drainage in 6 and vein harvest site hematoma in 1. These complications contributed to a 33% readmission rate. Among Group II patients, complications included recurrent thrombosis in one patient who was lost to follow-up and readmission for hemothorax requiring drainage in another.

Conclusions: FRR alone with EVT for residual compression and a more aggressive approach with FRR + venous reconstruction afforded equal symptomatic relief. Direct open venous reconstruction was associated with longer hospital stay, higher readmission rate, and higher perioperative complication rate than TOS decompression alone.

Intravenous Ultrasound (IVUS) Identifies Stenosis in Venographically Normal Appearing Veins at the Thoracic Outlet

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Objectives: The evaluation of subclavian vein compression at the thoracic outlet has relied on venography. The use of IVUS to assess the subclavian vein in a three-dimensional capacity may provide a more sensitive method to identify stenosis.

Methods: The subclavian veins of patients undergoing evaluation for venous thoracic outlet syndrome (vTOS) were evaluated by venography and IVUS in both the symptomatic and asymptomatic limbs. IVUS evaluation included measurement of area (mm2) at the lateral margin of the first rib (S1) and at the site of maximal compression (S2). Additional IVUS measurements included dimensions (mm): anterior-posterior (AP) and cranial-caudal (CC) at S1 and S2. Venography evaluation included determination of CC ratio between S1 and S2. Percent stenosis of areas determined by IVUS were calculated. The ratio of change in the AP and CC dimension between S1 and S2 were evaluated and compared to the change of CC ratio by venography.

Results: Twenty-seven limbs from 14 patients were evaluated by venography and IVUS for vTOS. Nine limbs from 7 patients were found to have venographically normal appearing veins. IVUS detected an average area stenosis of 59% ± 14% (range, 34.2%-73.9%) in venographically normal appearing veins. The ratio of change in AP dimension by IVUS between S1 and S2 is 2.34, while the CC dimension is 1.44. This compares to a change in CC ratio seen on venography of 1.09.

Conclusion: IVUS is highly sensitive in identifying changes in venous dimension and detects the presence of significant stenosis in vengraphically normal appearing veins at the thoracic outlet. The greatest change in venous diameter measured by IVUS occurs in the AP plane and is not seen on venography. This more accurate means of assessing venous compression may be clinically significant.